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Indian Journal of Surgery (October 2023) 85 (Suppl 2):S465–S470
https://doi.org/10.1007/s12262-022-03651-6

ORIGINAL ARTICLE

Descending Necrotizing Mediastinitis: Evaluation of 30 Cases

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Received: 16 December 2021 / Accepted: 7 December 2022 / Published online: 29 December 2022
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Abstract

Mediastinitis is an inflammation of the mediastinum. Descending necrotizing mediastinitis (DNM) is the most common form of mediastinitis. Symptoms of severe oropharyngeal infection, radiological evidence of mediastinitis, documentation of necrotising mediastinitis at surgery, and a relationship between the infection and a necrotizing process are all diagnostic criteria. The worsening conditions of fever, neck and chest pain, and respiratory distress are presenting features. Without aggressive surgical drainage, DNM may become fatal. Early diagnosis and prompt therapy play a crucial role in the management of mediastinitis. We aimed to compare the clinical features of mediastinitis. DNM cases that were treated in our clinics in the last 10 years were retrospectively reviewed. Patients with DNM were divided into three groups according to tomographic images. Demographic characteristics, accompanying diseases, anatomical localization, medical and surgical management, other clinical features, and morbidity and mortality rates of patients were collected and compared with univariate analysis. The adequacy of neck exploration or the need for additional surgery was determined by preoperative and postoperative computerized tomography evaluation. The etiologic causes of *DNM* were oropharyngeal in 12 cases and dental in 18 cases. The mean age of the 19 men and 11 women was 37 years. Mediastinal localization according to a computerized tomography image was type I in 11 patients, type IIA in 6 patients, and type IIB in 13 patients. The most common accompanying disorders were diabetes mellitus in 16.6%, cardiac disease in 10.0%, and hepatic in 3.3%. Neck exploration was performed in almost all cases. When the physicians failed to manage the patient with a single neck exploration procedure, mediastinoscopy, tube thoracostomy, and thoracotomy were added. In the series, 7/30 (23%) patients died. The mean duration of an intensive care unit stay was 29 days. Bacterial growth was cultured in 14 patients including all nonsurvivors. Because the prognosis is poor and the disease is more likely to spread below the carina in delayed cases, regardless of the aetiology or type of mediastinitis, aggressive surgery should be performed immediately.

Keywords Descending · Necrotizing · Mediastinitis · Infection

Introduction

Mediastinitis is an inflammation of the space between the two pleural cavities. Its most common causes are infection of mediastinal tissues and organs, descending necrotizing mediastinitis (DNM), sclerosing mediastinitis, trauma, chest surgeries, or iatrogenic interventions associated with oesophagus and bronchial injuries [1–3]. DNM is a special type where deep-seated infection in the cervical fascial planes is most commonly due to procedures on the teeth or gums, acute pharyngitis or tonsillitis leading to an abscess, or laryngo-pharyngotracheo-esophageal perforations due to sharp foreign bodies and/or attempted instrumentation. A local abscess forms. As the most severe form of all mediastinitis cases, DNM is associated with the highest death rates [2, 3].

The suggested criteria for the diagnosis of DNM are as follows: (1) severe oropharyngeal infection, (2) radiographic evidence of mediastinitis, (3) perioperative confirmation of both infections, and (4) identification of a link between oropharyngeal infection and mediastinitis [3]. DNM can be classified into three types based on computerized tomography (CT) findings (Fig. 1). Contamination of the

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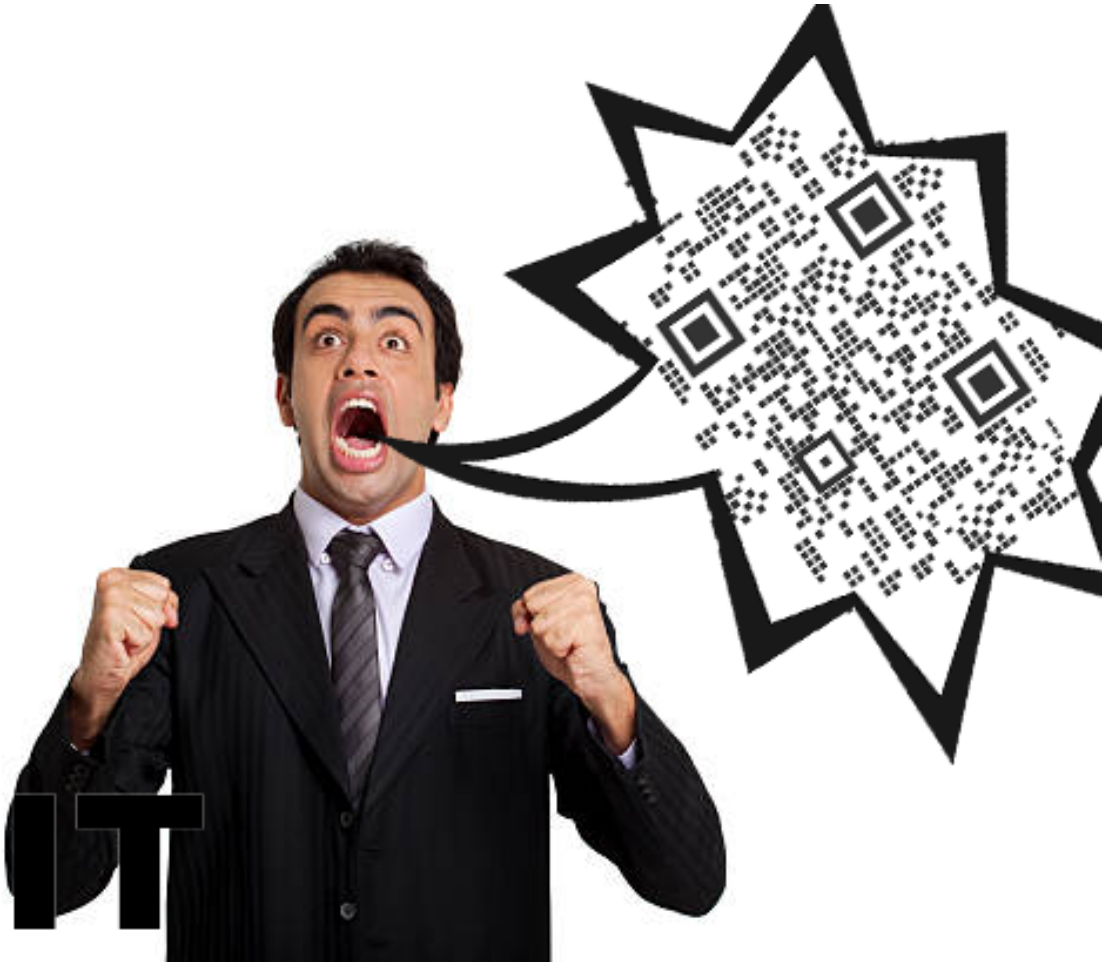

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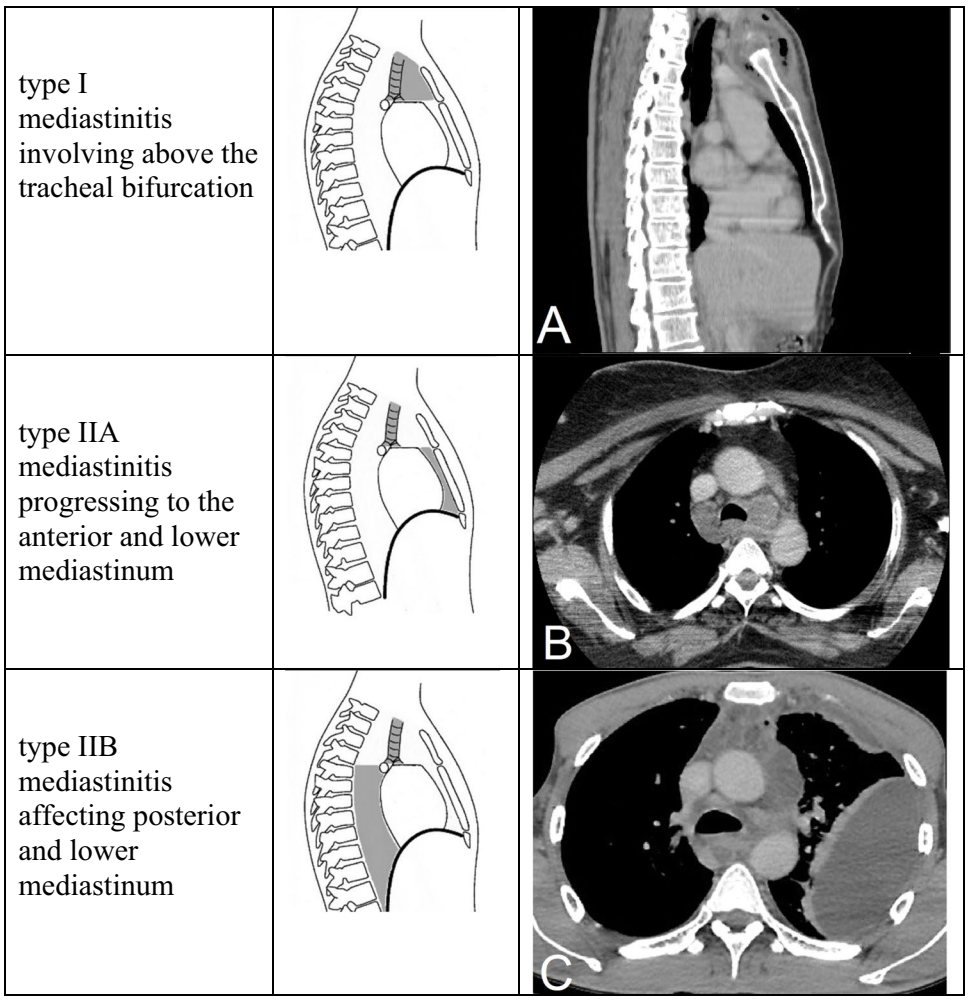
type I mediastinitis involving above the tracheal bifurcation
type IIA mediastinitis progressing to the anterior and lower mediastinum
type IIB mediastinitis affecting posterior and lower mediastinum
A
B
C

Fig. 1 Types of descending necrotising mediastinitis

mediastinum is the result of polymicrobial infections with anaerobic and aerobic microorganisms in the pharyngeal and oral flora that proceed to the mediastinum [4, 5]. There is an ongoing debate about the management of DNM. Early diagnosis and urgent surgical treatment are critical in all cases of mediastinitis, with up to 80% of patients successfully treated [1, 2, 6, 7].

Patients and Methods

Between January 2011 and January 2021, 30 consecutive patients with DNM were treated. Based on *CT* findings, these patients were divided into three groups according to anatomical localization (Fig. 1). A wide spectrum of antibiotic therapy with coverage for anaerobic bacteria was started. Empiric antibiotics were used for gram-positive, gram-negative, and anaerobic organisms. The treatment protocol was modified according to the culture results. The demographic features of the patients, including age, gender, comorbidities, clinical features, surgical methods, intensive care unit stay, morbidity, and mortality, were analysed. A physical examination, X-ray, thorax CT, and laboratory tests were performed to establish the diagnosis. Surgical treatments were neck exploration (NE), mediastinoscopy for mediastinal inlet after neck exploration, tube thoracostomy, and mediastinal pleural dissection with thoracotomy. Neck and thorax CT imaging were examined for preoperative and postoperative evaluation. Patients with type I mediastinitis underwent negative pressure aspiration. Tracheostomy was performed in cases of extensive NE. Intraoperative culture samples were obtained from cervical or mediastinal fluids. We preferred the escalation in surgical management following neck exploration.

Statistical Analysis

The statistical program SPSS 21.0 was used to analyse the data. For the statistical analysis, the chi-square test was used for comparing two categorical variables and nonparametric tests (Mann–Whitney *U* test) for comparing one continuous variable and one dichotomous variable.

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Results

Of the study group consisting of 30 patients, 19 were men (63.3%) and 11 were women (36.6%). The mean age was 36.65 (ranging from 16 to 65) years. The symptoms of the patients, according to the order of frequency, were fever, dyspnoea, neck swelling, sore throat, chest pain, neck pain, and dysphagia. Considering the aetiology of DNM, the focus was odontogenic, observed in 18 cases (60.0%). In terms of localization of mediastinitis, 11 patients (36.6%) were type I, 6 patients (20.0%) were type IIA, and 13 patients (43.3%) were type IIB (Table 1).

Eleven patients (36.6%) had comorbidity, DM in five patients (16.6%), a cardiac disorder in three (10.0%), a pulmonary disorder in one, renal parenchymal disease in 1, and a hepatic disease plus alcohol abuse in 1 patient (3.3%), respectively. One of the deaths had excessive alcohol intake and DM.

Neck and thorax CT imaging were examined for preoperative and postoperative evaluation. Preoperative radiological imaging using cervical tomography identified tissue oedema in 8 (26.6%), inflammation in 11 (36.6%), fluid accumulation in 13 (43.3%), and subcutaneous emphysema in 16 (53.3%) cases. Chest CT scans revealed pleural effusion in 22 (73.3%), pneumomediastinum in 20 (66.6%), mediastinal infiltration and fluid accumulation in 14 (46.6%), and pericardial effusion in 6 (20.0%) of the patients. In two patients who died, cervical tomography images showed fluid collection, subcutaneous emphysema, and tissue oedema. Also, pneumomediastinum, mediastinal fluid, an oedema-compatible image, pericardial effusion, and bilateral pleural effusion below the carina and posterior mediastinum were seen in the others.

Bacterial growth was seen in 14 (46.6%) of the intraoperative fluid samples. Methicillin-resistant *Streptococcus aureus* (MRSA) was isolated in 3, *Streptococcus viridans* in 4, *Streptococcus* species in 2, *Streptococcus agalactiae* in 1 case, *Klebsiella pneumonia* in 2 cases, and *Escherichia coli* in 2 patients, respectively. The cultural growth of four patients who died was positive. Among these, MRSA and *Candida albicans*, a fungal growth, were isolated in 2 cases. *Escherichia coli* was positive in the other two. Wide-spectrum antibiotherapy was started. Neck exploration was performed on 27 patients. All 11 cases of type I DNM had only neck exploration. Tube thoracostomy was carried out in 6 patients. VATS and thoracotomy were used in 5 and 8 patients; respectively. A tracheostomy was necessary for 3 patients.

Two patients underwent bilateral thoracotomies in addition to neck exploration and pleural dissection (6.6%). Additional surgical procedures were necessary for 19 patients with DNM due to the progression of the disease. All 11 cases of DNM (36.6%) were localized only to the upper mediastinum, type I group. In this group, only neck exploration was performed. As an additional surgical procedure, vacuum wound aspiration was used in 7 (63.6%) cases. Mortality was not seen in the type I group, while two patients in group IIA and five patients in group IIB died (Fig. 1). A thoracotomy was performed

Table 1 Clinical features of the DNM cases

Classification	I	IIA	IIB	*p value*
Gender m/f	7/4	4/2	8/5	*0.6*
Age, years (range 16–65)	31.18	38.33	40.53	*0.9*
Aetiology				
Oropharyngeal	6	1	5	*0.3*
Dental	5	5	8	
Therapeutic delay days	3.09	4.16	3.84	*0.5*
Symptoms				
Chest pain	1	3	6	*0.5*
Sore throat	3	4	5	
Neck swelling	7	3	3	
Dysphagia	2	2	2	
Neck pain	4	1	3	
Comorbidity				
Hepatic	-	-	1	*0.6*
Renal	1	-	-	
Cardiac	1	1	1	
Pulmonary	1	-	-	
DM	-	1	4	
CT findings				
Bilateral pleural effusion	-	1	5	*0.06*
Abscess/air	2	3	5	*0.3*
Infiltration	2	3	5	*0.3*
Pleural effusion	2	1	11	*0.01*
Pericardial effusion	0	2*	6*	*0.3**
Positive culture	6	4	4	*0.4*
Surgical interventions				
NE	11	7	9	*0.7***
TT	-	4	2	
VATS	-	2	3	
THC	-	3	5	
TS		1	3	
Number of interventions	11	17**	22**	
Outcome				
Sepsis	1	3***	5***	*0.6****
Survival	11	4	8	*0.06*
Mortality	0	2	5	*0.06*
Reinfection	1	1	2	*0.08*
ICU, duration, days	17.9	50.6	21.4	*0.3*

DM diabetes mellitus, *CT* computerized tomography, *THC* thoracotomy, *TT* tube thoracostomy, *VATS* video-assisted thoracoscopic surgery, *NE* neck exploration, *TS* Tracheostomy, *ICU* intensive care unit; Asterisks indicate the values being compared.

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in 3 (33.3%) cases, and neck exploration was performed in 7 (77.7%) cases. In nine cases, an additional surgical procedure was performed. Two patients in this group died. There were 13 patients in the type IIB mediastinitis group, extending to the subcarinal and posterior mediastinum. Nine cases underwent neck exploration, and a thoracotomy was performed in 5 cases in this group.

All the patients underwent additional surgery for better drainage. Five of the 13 patients with type IIB died. The mean duration of ICU stay in type I, type IIA, and type IIB mediastinitis was 17.9 days, 50.66 days (the median duration was 26 days), and 21.46 days, respectively. The mean duration of ICU stays was 30.31 days for patients with comorbidity, while it was only 18.54 days for patients without comorbidity. The mean duration of an ICU stay was 26 (4–210) days. Seven patients (23.3%) died.

There was no statistically significant difference between the three groups in terms of age, gender, aetiology, therapeutic delays, symptoms, comorbidity, and culture results, except for CT findings, surgical procedures, and sepsis.

Discussion

As an uncommon, acute, and polymicrobial infection of the mediastinum, DNM is associated with high mortality and morbidity rates. It can develop rapidly after an odontogenic or oropharyngeal infection. Some authors define mediastinitis due to oesophageal injury as DNM. However, a common consensus was not provided or reached [1, 3, 8, 9]. DNM is more common than other causes of mediastinitis. The male gender is more common. Poor oral hygiene, diabetes mellitus, excessive alcohol use, immune suppression, and radiation exposure are the common risk factors [1, 3, 7, 10]. A meticulous clinician can easily diagnose or suspect an infection early and aspirate or drain the accumulated pus. If neglected, the abscess will burst and spread rapidly down the fascial planes into the mediastinum, affecting a part or whole of the mediastinum. Mediastinitis is inevitable due to microbial agents of the oral flora spreading to the mediastinal area [4, 5, 11, 12]. The infection may also be transmitted to the mediastinum through lymphoid or haematogenous pathways or direct contamination [1–3]. These polymicrobial infections constitute a necrotizing process that complicates the pleural spaces, pericardium, and abdominal cavities. This progression of DNM results in empyema, abscess, pleural effusion, pericardial effusion, intrathoracic haemorrhage, cardiac tamponade, and sometimes the death of patients [13]. The most important factor in a clinical case study is a meticulous clinical history from the onset of the illness and its subsequent course.

CT is essential for the early diagnosis of DNM and an important tool in determining anatomic locations. Cervical and thoracic CT scans are also the gold standard for postoperative follow-up and the need for additional surgery after the operation [6, 14–16]. A contrast medium is used in oesophagography to definitively diagnose cervical oesophageal injuries. The common view of the studies can be summarized as “early diagnosis and aggressive surgical treatment of mediastinitis reduce mortality and morbidity”. Regardless of aetiology, surgical treatment of patients should be planned immediately when diagnosed. Cervical and thoracic CT images play a crucial role in surgical evaluation in all mediastinitis, and the requirement for aggressive surgical treatment is confirmed according to the involvement of the upper or lower carina. In lesions above the carina, it is usually necessary to perform abscess drainage and necrotic tissue debridement with a wide cervicotomy. In lesions spreading lower the carina and throughout the mediastinum, abscess drainage or pleural dissection can be planned in conjunction with other surgical treatments (sternotomy, thoracotomy, clamshell incision) [3–7, 13–18]. In a study, the surgical approach to mediastinitis was reported to be related to supracarinal or infracarinal involvements of the disease [19]. In another study, DNM was divided into three types according to anatomic distribution. In type I, it was considered to be above the bifurcation which was not always required for aggressive surgery. Type IIA has separated the anterior and lower mediastinum and is therefore invasive. For type IIA, a subxiphoid or thoracoscopic approach was adequate. The common type of posterior and lower mediastinum is type IIB. In addition to the cervical approach, a thoracic approach and dissection of large mediastinal dissection are recommended in type IIB [14]. Transcervical drainage alone is sufficient for mediastinitis with localized upper mediastinum. Mediastinitis extending under the anterior and posterior mediastinum may require dissection of the entire mediastinum with a thoracotomy in addition to cervical drainage [6, 7, 14, 19, 20]. In our study, we divided the mediastinitis area into three anatomic regions according to CT images. Abscess drainage and debridement of the necrotic tissue under the neck exploration were sufficient only for mediastinitis with limited upper mediastinum (type I). Mediastinoscopy, pleural dissection with single or bilateral thoracotomy, tube thoracostomy, and other additional surgical procedures (tracheostomy, etc.) were performed at the carina level (type IIA and type IIB) mediastinitis in addition to neck exploration. Mediastinitis in the posterior and inferior mediastinum (type IIA) was more invasive than other mediastinitis types in terms of recovery time and mortality rate. Patients with type IIB mediastinitis were subjected to wider surgery. It was stated that minimally invasive procedures such as subxiphoid or anterior mediastinotomy were inadequate in the treatment of mediastinitis, and the combination of cervical and thoracic surgeries reduced the mortality from 47 to 19% [20]. In another study, cervical

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dissection and emergency thoracotomy in all cases below the carina level reduced mortality and ICU stay by under 20%. The mortality rate was 18%, and the mean ICU stay was 30 days [21].

Due to the involvement of the carina, cervicotomy and mediastinoscopy were sufficient for 10 patients, but seven patients with subcarinal involvement required sternotomy and thoracotomy in a study [19]. In the same study, mortality rates were around 6%, and the mean ICU stay was expressed as 30 days. The high mortality rate was attributed to the late admission of patients with ambiguous clinical characteristics [8]. The mean duration of ICU in our study was 26.0 days. Considering the aetiology of mediastinitis, the longer duration of ICU stay was attributed to the application of additional surgical procedures, the recurrence of resistant bacteria, and the comorbidity. The mortality rate was 23.3%. The distribution of mortality rates according to aetiology was 16.7% in DNM type IIA. Higher mortality rates were related to diagnostic delay or resistant bacteremia. Hyperbaric oxygen and immunotherapy can be used as an alternative therapy in some selected cases [22]. The longer the delay between diagnosis and the onset of treatment, the more advanced the stage, the more aggressive the necessary therapy, and the worse the prognosis. The major limitation of our study is the low sample size, which is the most important determinant for reaching a precise conclusion. Compared to previous reports, the rate of DNM was higher in our study, possibly related to poor hygiene or dental infections and a higher frequency of diabetes among our study population.

DNM is eminently preventable, and the thrust should be on this aspect. The importance of clinical examination cannot be overemphasized. Relying on high tech often leads to these messy situations at great cost to the patient, family, and healthcare institutions. The first principle of managing an abscess anywhere is the adequate evacuation of the pus by whatever means are established as appropriate in a given patient. Neglect of timely clinical examination and appropriate action and indiscriminate use of antibiotics are the reasons behind all DNM. Once DNM is established, it calls for critical care, which is established as necessitating high-tech imaging and intensive therapy. These basic principles have been known for over decades but continue to be neglected in the modern era despite all the high technology.

In conclusion, descending necrotizing mediastinitis is a challenging form of mediastinitis with the same complications and high mortality and morbidity that lead to the same clinical condition and can be managed with similar diagnostic and treatment methods. Neck exploration is usually sufficient for descending necrotizing mediastinitis patients with limited mediastinitis to the upper mediastinum. However, neck exploration alone is not sufficient for both types of mediastinitis, extending to the carina or below. In addition to neck exploration, additional surgical choices should be made immediately. Comorbidities like DM, recurrence of resistant microorganisms, additional surgical interventions, or type IIA or IIB mediastinitis are the most important factors increasing the necessity of an ICU stay. Higher mortality rates are related to type IIA or IIB mediastinitis, growth of resistant bacteria in cultures, delayed diagnosis, and DM.

Author Contribution All authors have made substantial contributions to the conception and design of the study, the acquisition of data, or the analysis and interpretation; to the drafting of the article or revising it critically for important intellectual content; and to the final approval of the version to be submitted. All authors endorse the data and conclusions.

Data Availability The authors confirm that the data supporting the findings of this study are available within the article [and/or] its supplementary materials.

Declarations

Competing Interests The authors declare no competing interests.

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